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TAXONOMIC NOVELTIES FROM WESTERN NORTH AMERICA IN *MENTZELIA* SECTION *BARTONIA* (LOASACEAE)

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Abstract

Recent field collections and surveys of herbarium specimens have raised concerns about species circumscriptions and recovered several morphologically distinct populations in *Mentzelia* section *Bartonia* (Loasaceae). From the Colorado Plateau, we name **M. paradoxensis** from Paradox and Gypsum valleys of western Colorado, which is closely related to *M. marginata*. We name **M. holmgreniorum** from northeastern Arizona and **M. filifolia** from the northern border region of Arizona and New Mexico, both of which share morphological similarities with *M. lagarosa*, *M. laciniata*, and *M. conspicua*. From north central New Mexico, we name **M. sivinskii**, which is most closely related to *M. procera* and *M. integra*. We describe three varieties of *M. longiloba*, including **M. longiloba** var. **yavapaiensis**, which is distributed throughout Arizona, **M. longiloba** var. **pinacatensis**, which is narrowly distributed in the Pinacate Desert of Sonora, Mexico, and the northern Chihuahuan Desert **M. longiloba** var. **chihuahuaensis**. We propose the new combinations **M. lagarosa** and **M. procera** to alleviate the polyphyly of *M. pumila*.

Key Words: Cryptic species, intermountain West, new species, polyphyletic taxa, systematics.

Mentzelia section *Bartonia* (Loasaceae) is a monophyletic group (Hufford 2003; Hufford et al. 2003; Schenk 2009) dispersed throughout the arid North American West. The taxonomy of the section and collection limitations (Thompson and Prigge 1986) have long encumbered a clear understanding of the biological diversity of the group. Collections made in the last two decades have expanded our knowledge of diversity in the section and resulted in the description of 15 new species. Many of these recently described species are associated with restrictive substrates (e.g., gypsum-rich soils) and are narrowly distributed (Prigge 1986; Holmgren and Holmgren 2002; Schenk et al. 2010).

As part of a revisionary study of *Mentzelia* section *Bartonia*, we have made extensive new collections of the group, especially to examine the distribution and circumscriptions of poorly delimited taxa. This fieldwork and an accompanying survey of herbarium collections indicated that some populations possess morphological states that could not be readily accommodated in existing taxa in section *Bartonia*. The possibility that the existing taxonomy of the section does not capture the diversity that is present among natural populations has led us to sample distinctive populations as part of phylogeny reconstructions based on molecular data to examine their relationships to better known species (Schenk 2009). We have used insights from the fieldwork, survey of herbarium specimens, and the phylogenetic placements of distinctive populations as a guide to their taxonomic treatment. Our results indicate that several populations are independent evolutionary lineages that do not readily fit existing species circumscriptions, and we describe these entities as new species. Several evolutionary lineages found to be associated with *M. longiloba* J. Darl. are morphologically and geographically distinctive (Schenk 2009), and we describe these as varieties of *M. longiloba*. In addition, our related molecular phylogenetic studies (Schenk 2009) also indicate that *M. pumila* Torr. & A. Gray as treated by Darlington (1934) and Thorne (1986) is polyphyletic. In order to alleviate the polyphyly of *M. pumila*, we make two new combinations.

Materials and Methods

Field observations of nearly all species of *Mentzelia* section *Bartonia* and a study of our recent collections and specimens, including types, in herbaria were used to assess population and species variation. Morphological measurements were taken with digital calipers, using a dissecting microscope when necessary. Leaf characters were measured separately for leaves on the lower 1/3 and upper 1/3 of main stem or renewal axes. Leaf measurements were not taken from secondary or higher order (lateral, nonrenewal) branches because they often differed in size and shape from those on main stems. Leaf lengths were measured from the distal tip of the lamina to the junction of the leaf base with stem. Leaf widths were measured at the widest point of the lamina.

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The rachis width was measured as the distance across the sinuses at the shortest length between lobes (if present) and at the widest point of the lamina. Lobe width (when lobes were present), a measure across lobes, was measured at mid-length for a lobe positioned at the widest point of the leaf. The number of lobes per leaf included the total number of lobes on both margins of the leaf. Trichome densities and composition on leaves were characterized for both abaxial and adaxial surfaces of the lamina, excluding the central vein and margins. Prophylls either subtended all flowers or were adnate to the ovary. Prophyll measurements were made for the most distal bract that either subtended a flower or was adnate to a flower ovary. Calyx lobe lengths were measured from the base of a lobe to its distal tip, excluding the calyx tube and hypanthium. Petal lengths were measured from the base of a petal to its distal tip. Petal and median antesepalous (=outermost) stamen widths were measured at their widest points. We characterized petals as narrowly to broadly spatulate, oblanceolate, or elliptic based on assessment of overall shape. Elliptical (broadest near mid-length) and oblanceolate (broadest distal to mid-length) petals largely lacked a differentiated claw and limb in contrast to spatulate petals, which had distinct claw and limb regions. Styles were measured from the top of the ovary to the tip of the stigma lobes. Flower colors were based on field observations using the Royal Horticultural Society color chart and label data on herbarium specimens. Capsule lengths were measured from the ovary base to the insertion of calyx/hypanthium at the ovary apex on mature fruits. We denoted capsules as cup-shaped when they are less than twice as long as wide and cylindrical when more than twice as long as wide. We measured four (only for **M. holmgreniorum**, which is known from few collections) to 36 specimens for each new entity described below, as well as numerous specimens of previously described species.

Seed surface characters were assessed using scanning electron microscopy (SEM). Three seeds or more per sampled taxon were examined. Seeds were obtained from herbarium specimens or from field collections, mounted on metal stubs, and coated in gold prior to imaging. Seeds were examined at 20 kV using a Hitachi S-570 SEM, and micrographs were made of two seeds per accession at 700× or 600×.

Locality data for populations were gathered during fieldwork and from herbarium specimens. Latitude and longitude for new collections were made in the field using GPS. If herbarium specimens lacked field measured coordinates, we used the township, range, and section (TRS) data to infer latitude and longitude coordinates using Graphical Locator (Gustafson 1995). GEOLocate v2.13 (www.museum.tulane.edu/geolocate/) and Google Earth (earth.google.com/) were used to estimate latitude/longitude coordinates if only limited locality information was available. Distribution data that could not be georeferenced accurately were not included in distribution maps. To image distributions of species, we imported population locality coordinates into ArcGIS v9.2 (ESRI, Redlands, CA).

New Combinations

Mentzelia procera (Wooton & Standl.) J. J. Schenk & L. Hufford, stat. et comb. nov. *Nuttallia procera* Wooton & Standl., Contributions from the U.S. National Herbarium, 16: 150, 1913; *Mentzelia pumila* Torr. & A. Gray var. *procera* (Wooton & Standl.) J. Darl., Annals of the Missouri Botanical Garden, 21: 169, 1934.—Type: USA, New Mexico, White Sands, 18 August, 1907, *Wooton & Standley s.n.* (holotype: US; isotype: NMC).

Mentzelia lagarosa (K. H. Thorne) J. J. Schenk & L. Hufford, stat. et comb. nov. *Mentzelia pumila* Torr. & A. Gray var. *lagarosa* K. H. Thorne, Great Basin Naturalist, 46: 558, 1986. —Type: USA, Utah, Uintah Co., T11S, R24E, S11, near Watson, Evacuation Creek, 10 mi., 173 degrees from Bonanza, 1708 m, on gravel, 1 August 1980, *Goodrich & Atwood 14664* (holotype: BRY; isotype: NY).

Mentzelia pumila was treated broadly as a taxon widely distributed in the North American West in the monograph of Loasaceae by Urban and Gilg (1900) and the revision of *Mentzelia* by Darlington (1934). In contrast, Hill (1977) argued that *M. pumila* was restricted to the Red Desert of Wyoming, and Holmgren et al. (2005) treated it as restricted to Wyoming and adjacent portions of southern Montana and northeastern Utah, recognizing the name as misapplied to populations outside of this area. Schenk (2009) recognized the range of *M. pumila* as identical to that inferred by Holmgren et al. (2005) and demonstrated that an exemplar for *M. pumila* from Wyoming is phylogenetically isolated from lineages referable to *M. pumila* var. *procera* (*sensu* Darlington 1934) from New Mexico and surrounding areas and *M. pumila* var. *lagarosa* (*sensu* Thorne 1986) from southern Utah and Nevada. The new combinations recognize *M. pumila*, *M. lagarosa*, and *M. procera* as independent evolutionary lineages.

The variety *lagarosa* was placed as part of *M. pumila* based on identical chromosome numbers ($n = 11$) and similar growth habit (Thorne 1986). The pinnatisect laminas and sinuate anticlinal cell walls of seed testal cells of *M. lagarosa* distinguish it from *M. pumila*, which has pinnately-lobed laminas and straight anticlinal walls on seed testal

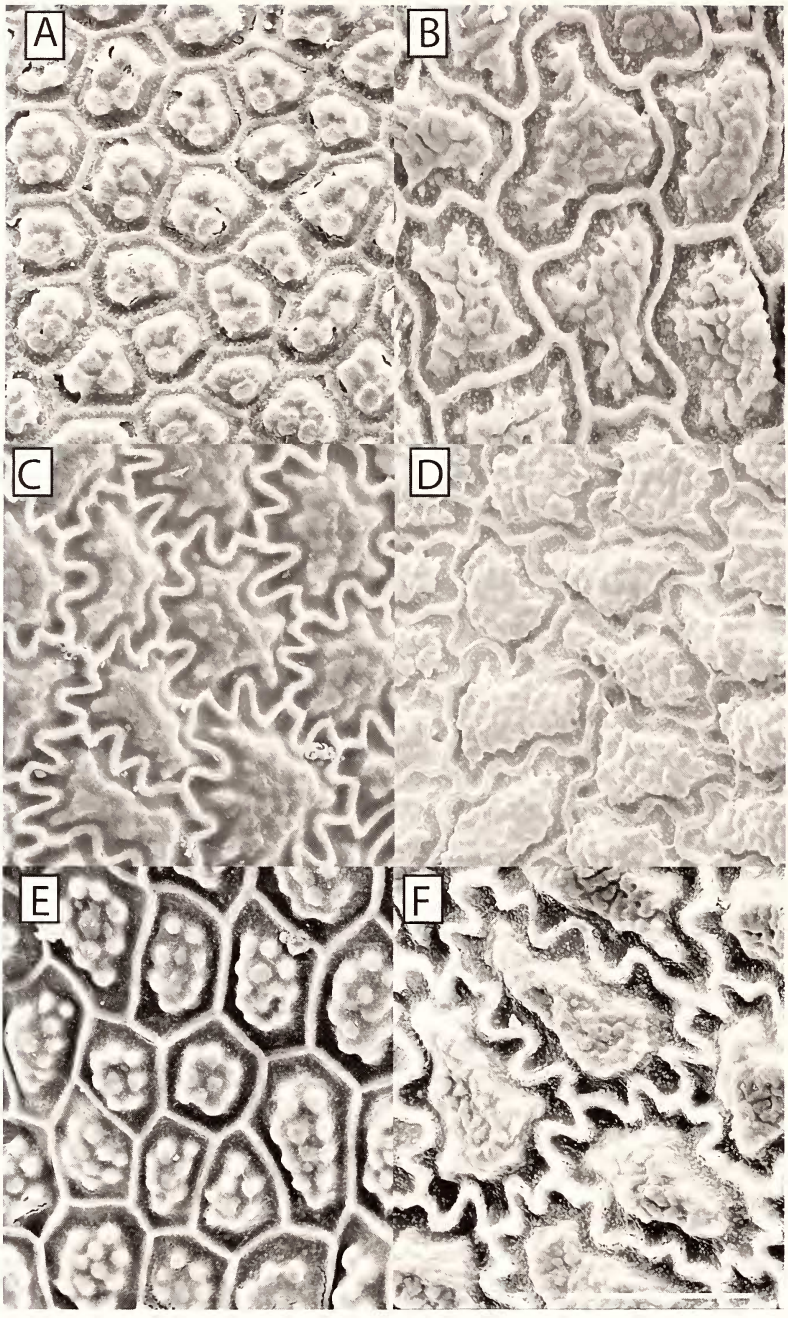

FIG. 1. Scanning electron micrographs of seed coat testal cells. A. *Mentzelia pumila*, B. *M. lagarosa*, C. *M. procera*, D. *M. filifolia*, E. *M. mexicana*, F. *M. multiflora*.

cells (Fig. 1). Populations of *M. lagarosa* occur in Colorado, Nevada, and Utah and are disjunct from the populations of *M. pumila*. The sister relationship of *M. lagarosa* remains uncertain (Schenk 2009); however, its narrowly dissected laminas, floral forms, and seed microsculpture characters are similar to taxa such as *M. laciniata* (Rydb.) J. Darl., *M. conspicua* T.A. Todsen, and **M. filifolia**, which is described below.

Mentzelia procera can be distinguished from *M. pumila* by sinuate versus straight anticlinal walls of seed coat testal cells (Fig. 1), respectively. The two species have overlapping morphological states, although petal lengths (9.5–16.3 mm vs. 11.5–20 mm) and capsule size (9.8–18.8 mm vs. 11.5–20 mm) are generally smaller in *M. procera* than in *M. pumila*. *Mentzelia procera* occurs in New Mexico and Colorado and is disjunct from *M.*

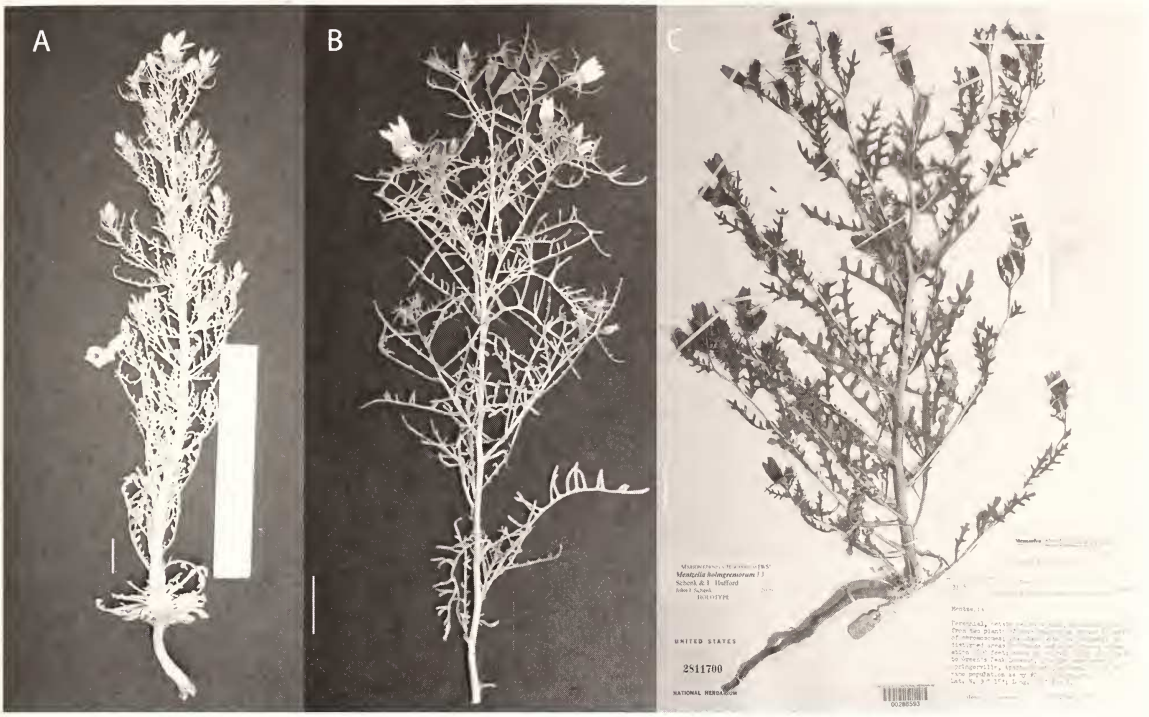

FIG. 2. Type specimens of newly described species. A. *M. paradoxensis*, B. *M. filifolia*, and C. *M. holmgreniorum*. Scale bars = 3 cm.

pumila. Molecular phylogenetic results (Schenk 2009) indicate that *M. procera* is more closely related to *M. integra* (M. E. Jones) Tidestr. and **M. sivinskii** (described below) than it is to *M. pumila*.

NEW SPECIES

Mentzelia paradoxensis J. J. Schenk & L. Hufford. sp. nov. (Fig. 2A).—Type: USA, Colorado, Montrose Co., Paradox Valley, along Hwy 90, 12.7 rd mi SW of its jct with Hwy 141, E of Bedrock and Dolores River, 38°16.556′N, 108°47.632′W, 2 Jun 2006, *L. Hufford 4475* (holotype: WS; isotype: COLO, NY, RM, UC, US).

Habitus singularus erectus, axillarus ramus brevus; caudex singularis; folia alterna elliptica vel lanceolata, margine lobata; petala 5, flavidus, spatulata; staminodia extima petaloidea; seminum testa in alam expansa.

Biennial herbs, up to 9 dm tall; taprooted. Main stem erect, straight, lateral branches on distal half of main stem or along the entire main shoot, lateral branches perpendicular to main stem along its basal region but branching acutely upward relative to the main stem along its distal region, branches straight; decumbent branches absent; epidermis pubescent, becoming white, exfoliating with age. Leaves alternate; rosette leaves narrowly to broadly spatulate, petiolate; cauline leaves 38–91 × 6–17(21) mm, rachis width 1.6–4.7 mm; leaves on lower third of main stem oblanceolate, lanceolate, or elliptic, margins dentate to serrate or pinnate with 8–22 lobes, 4.5–11(15) mm apart, lobes nearly opposite, lobe slightly angled towards leaf apex or perpendicular to leaf axis, regular, up to 2–6.8(9) mm long with acute to occasionally rounded apices, margin revolute; leaves on upper third of main stem elliptic to lanceolate with non-clasping bases, margins dentate to serrate or pinnate with 8–16 lobes, 5.4–11.7(14) mm apart, lobes nearly opposite and slightly angled towards leaf apex or perpendicular to leaf axis, regular, up to 2.4–5(8.5) mm long with acute to occasionally rounded apices, revolute, pubescent, with greater density of simple grappling-hook, complex grappling-hook, and needle-like trichomes on abaxial surface, needle-like and occasionally simple grappling-hook trichomes on adaxial side. Inflorescence cymose, bract subtending inferior ovary entire, 2.5–11 × 0.4–1.1 mm. Calyx apices acute to attenuate, margin entire, 2.2–7.6 × 0.8–2.4 mm. Petals five, yellow, pubescent on abaxial surface, narrowly spatulate, 8.3–15(17.2) × 1.7–5.3 mm, apex acute to rounded. Androecium yellow, stamens numerous, those of inner whorls shorter than outer whorls, filaments glabrous, anther epidermis papillate or not, anther occasionally twisted or remaining straight following dehiscence; outer whorls of stamens all fertile or fertile and

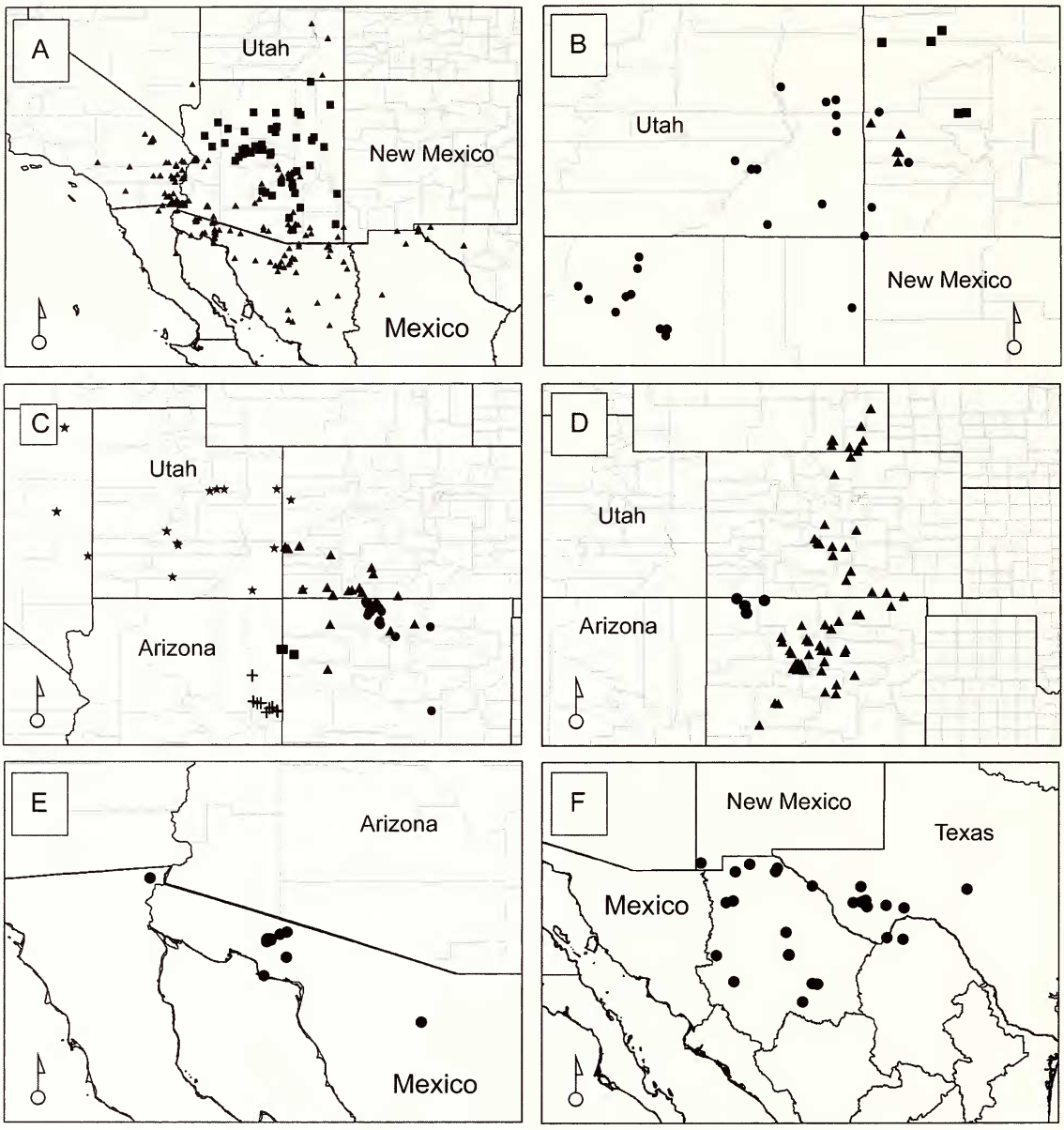

FIG. 3. Distributions of newly described taxa and selected relatives in USA and Mexico. A. *M. longiloba* var. *yavapaiensis* (■) and *M. longiloba* var. *longiloba* (▲). B. Distribution of *M. cronquistii* (●), *M. marginata* (■), and *M. paradoxensis* (▲). C. *M. laciniata* (▲), *M. conspicua* (●), *M. holmgreniorum* (+), *M. lagarosa* (★), and *M. filifolia* (■). D. Distribution of *M. sivinskii* (●) and *M. multiflora* (▲). E. *M. longiloba* var. *pinacatensis* (●). F. *M. longiloba* var. *chihuahuaensis* (●).

staminodial, five outermost stamens in median antesepalous positions petaloid, narrowly spatulate, 6–13 × 1.2–3.8 mm, with or without anther, filament or staminode apex rounded to occasionally acute; second whorl of stamens all fertile. Ovary inferior, 3-carpellate with 3 placentae, funnelform; style 5.4–10.4 mm long, stigmas three. Fruit a capsule, cup-shaped, 5–9 × 3.7–6.5 mm, opening apically by three valves, base rounded, no prominent longitudinal costal ridges. Seeds pale grey to light brown with a white to light brown wing, lenticular-ovoid, 1.7–2.7 mm long; testa reticulate, seed coat anticlinal cell walls straight to slightly wavy, central papillae generally 6–11 per cell. Chromosome number not determined.

Phenology: Flowering occurs from June to September.

Distribution: Populations occur in the Paradox and Gypsum Valleys of western Colorado at 1585–1964 m elevation (Fig. 3). Plants occur on road cuts, valley slopes and bottoms, and sparsely vegetated gypsum knolls.

Etymology: *Mentzelia paradoxensis* is named for the Paradox Valley of western Colorado.

Representative specimens: USA. COLORADO. **Montrose Co.**: W Paradox, *Payson 2323* (RM); Paradox, *Walker 157* (RM); Paradox Valley, along Hwy 90, 12.5 mi from its jct with Hwy 141, *Hufford 4335* (WS); Paradox Valley, along Hwy 90, just E of Bedrock and 0.2 mi E of Dolores River and 1.2 mi W of its jct with River Rd (Rd Y11), *Hufford 4336* (WS). **San Miguel Co**: Hwy 141, on gypsum knoll across from mi post 36, on the western-most gypsum knolls of the E edge of the Big Gypsum Valley, W of Slick Rock, *Schenk 972* (WS); Paradox Formation N of mi post 26 on Hwy 141, T46N R16W S14, *Atwood 28894* (RM); 19 mi S of 141/145 jct on Hwy141 between mi post 36–37, Big Gypsum Valley, T43N R16W S03, *Atwood 28897* (RM); ca. 20 mi S of 141/145 jct on Hwy 141, Big Gypsum Valley, 38°01.480′N, 108°38.885′W, *Atwood 28899* (RM); T44N R16W S31, *M. Ownbey 1497* (GH, WS); Gypsum Valley, State Hwy 141, 11.6 km (7.2 mi) SW of Basin, T44N R16W S32, 38°01′32″N, 108°39′01″W, *N. & P. Holmgren 13694* (WS).

The phylogenetic analysis of Schenk (2009) placed *M. paradoxensis* as sister to *M. marginata* (Osterh.) H. J. Thomp. & Prigge. The distribution of *M. paradoxensis* is south of the range of *M. marginata* (Fig. 3). Similar to *M. cronquistii* H. J. Thomp. & Prigge and *M. marginata*, *M. paradoxensis* has trichomes on the abaxial surfaces of petals. Collections of *M. paradoxensis* have been identified as *M. cronquistii*, and this may be a consequence not only of the petal trichomes but also their similar leaf laminas that are narrow and have long, acute lobes. *Mentzelia paradoxensis* differs from *M. cronquistii*, *M. marginata*, and other members of section *Bartonia* in having a shoot system characterized by many short lateral branches, at least in the lower portion of the main stem, that are nearly the same length along the main shoot. The numerous, short branches of *M. paradoxensis* give the whole shoot a cylindrical form and densely branched appearance. In contrast, both *M. cronquistii* and *M. marginata* have more candelabrum-shaped shoot systems. *Mentzelia paradoxensis* further differs from *M. cronquistii* in having smaller capsules. In contrast to *M. marginata*, which has leaf lobe apices that are rounded to occasionally acute, outermost stamens that are fertile, and long capsules (7–14.5 mm), *M. paradoxensis* is characterized by leaf lobes that have acute apices, outermost stamens that are staminodial or fertile, and short capsules (5–9 mm).

Mentzelia filifolia J. J. Schenk & L. Hufford, sp. nov. (Fig. 2B).—Type: USA, New Mexico, McKinley Co., W of Gallup, Pima Rd, 2nd rd E of Hilltop Rd, 0.4 miles N of NM Route 264, 1.3 mi E of AZ border, 35°39.126′N, 109°01.571′W, 4 Aug 2006, *J. Schenk 1659* (holotype: WS; isotypes: ARIZ, ASC, NMC, NY, RENO, UNM, US, UTC, WS).

Habitus singularis erectus; caudex singularis; folia alterna elliptica vel lanceolata, margine pinnatisecta filia; petala 5, flavidus, spatulata; staminodia extima petaloidea; seminum testa in alam expansa.

Biennial herbs, up to 7.5 dm tall; taprooted. Main stem erect, straight, lateral branches on distal half of main stems at acute angles, straight; epidermis pubescent, becoming white, shedding with age. Leaves alternate, rosette leaves unknown; cauline leaves 43–94(115) × 7.5–27(36) mm, rachis filiform, 1–2.4 mm wide; lower third of main stem oblanceolate to elliptic, margins filiform, pinnatisect with 8–20 lobes, 6–9 mm apart, nearly opposite, perpendicular, regular, up to 3.2–12(15.7) mm long with acute apex, margins revolute; upper leaves oblanceolate to elliptic with non-clasping bases, margins filiform, pinnatisect with 8–20 lobes, 7–12 mm apart, nearly opposite, perpendicular, regular, up to 5.6–17 mm long with acute apex, margins revolute; pubescent, abaxial surface with greater density of simple grappling-hook, complex grappling-hook, and occasionally with needle-like trichomes than adaxial surface, adaxial surface with needle-like trichomes. Inflorescence cymose, bract subtending inferior ovary entire to pinnate, 7–20 × 0.5–5.6 mm. Calyx 6–11 × 1–3 mm, apices acute to attenuate, margins entire. Petals five, yellow, glabrous on abaxial surface, oblanceolate, 14–18.5 × 3.6–6 mm, apex acute. Androecium yellow, stamens numerous, those of inner whorls shorter than outer whorls, filaments glabrous, anther epidermis not papillate, straight following dehiscence; outer whorl of stamens fertile and staminodial, five outermost stamens in median antesepalous positions petaloid, oblanceolate, 10.3–14(18) × (1.4)2.5–4.4 mm, without anther, staminode apex acute; second whorl of stamens all fertile. Gynoecium 3-carpellate, ovary inferior, funnelform, 3 placentae; style 10–12.5(14) mm long, stigmas 3. Fruit a capsule, cylindrical, 11–19.3 × 5–7.5 mm, opening apically by three valves, base tapering, costal ridges running lengthwise diminutive. Seeds grey to light brown, lenticular-ovoid, winged, 2.9–3.2 mm; testa reticulate, seed coat anticlinal cell walls sinuate, central papillae generally 42–48 per cell. Chromosome number $n = 10$ (*Thompson 3553* [US]).

Phenology: Plants flower from July to August.

Distribution: Populations occur in Apache Co., Arizona, and McKinley Co., New Mexico, where they occur on road-cuts and slopes of dark loam and rocky soils at 2122–2133 m elevation (Fig. 3).

Etymology: The specific epithet refers to the filiform lobes and narrow rachis of leaf laminas that serve to distinguish *M. filifolia* from other *Mentzelia* species of Arizona and New Mexico.

Representative specimens: USA. ARIZONA. **Apache Co.**: S of Wheatfields Lake, near turnoff to Crystal, along rd from Lukachukai to Fort Defiance, *Mason 2051* (ARIZ); Rte 12, 0.3 mi N of Rte 264, 35°39.792′N, 109°05.440′W, *Schenk 1660*, *1661* (WS). NEW MEXICO. **McKinley Co.**: along rd to Lukachukai, about 3 mi N of Red Lake and 2 mi S of jct of rd to Crystal, *H. Thompson 3553* (ARIZ); Gallup, *Herrick 893* (US); July 1961 spoils, *W. Wagner 161* (UNM); May 1963 spoils, *W. Wagner 198* (UNM); near mine entrance along roadside, *W. Wagner 314* (UNM); on the S end of the July 1961 spoils, *W. Wagner 370* (UNM); N of Gallup, *Wooton 2800* (US), 3 Aug 1904, *Wooton s.n.* (US).

Darlington (1934) treated the populations recognized here as *M. filifolia* as part of *M. laciniata*. We observe that *M. filifolia* has leaves that are more filiform than those of *M. laciniata* and other similar species, including *M. conspicua*, **M. holmgreniorum** (described below), and *M. lagarosa*, which also have thin, pinnate lobes along the narrow rachis of their leaf laminas, but not as narrow as *M. filifolia*. All five of these species, which occur in the southeastern portion of the Colorado Plateau (Fig. 3), are similar in having yellow petals and seed testal cells that have sinuate anticlinal walls. Henry Thompson recognized this entity earlier by annotating herbarium specimens of *M. filifolia* using the specific epithet "navajoa."

Molecular phylogenetic results (Schenk 2009) place *M. filifolia* as sister to the Chihuahuan Desert endemic *M. mexicana* H. J. Thomps. & Zavort., but this relationship has little support. *Mentzelia filifolia* differs from *M. mexicana* in having pinnatisect versus pinnately-lobed laminas, larger flowers, and sinuate versus straight to wavy anticlinal cell walls of the testal cell walls (Fig. 1). We note that the pinnatisect laminas of *M. filifolia* are morphologically most similar to those of *M. laciniata*, *M. lagarosa*, and *M. conspicua*. The lack of support for the relationship of *M. filifolia* and *M. mexicana* in conjunction with the morphological similarities it has to other species begs a more thorough study of the phylogenetic relationships of *M. filifolia*.

Mentzelia holmgreniorum J. J. Schenk & L. Hufford, sp. nov. (Fig. 2C).—Type: USA, Arizona, Apache Co., along US Hwy 60 at side rd to Green's Peak Lookout, 17 mi NW of Springerville, 30°15′N, 109°33′W, 20 Aug 1960, *H. Thompson 3108* (holotype: US; isotype: US).

Habitus singularis erectus; caudex singularis; folia alterna elliptica vel lanceolata, margine pinnatisecta; petala 5, flavidus, spatulata; staminodia extima petaloidea; seminum testa in alam expansa.

Biennial herbs, up to 5 dm tall; taprooted. Main stem erect, straight, lateral branches on distal half of main stem or along the entire main shoot, lateral branches at acute upward angles to shoot, curved; epidermis pubescent, becoming white, exfoliating with age. Leaves alternate; rosette leaves narrowly to broadly spatulate, petiolate; cauline leaves 42–89 × 11–31.9 mm, rachis width 2.3–3.6 mm; leaves on lower third of main stem oblanceolate to elliptic, margins pinnatisect with 14–20 lobes, 4.6–10.3 mm apart, lobes opposite, lobes strongly angled towards leaf apex, regular, up to 4.9–14.4 mm long with rounded apices, margins revolute; leaves on upper third of main stem lanceolate with non-clasping bases, margins pinnatisect with 12–18 lobes, 6.8–7.9 mm apart, lobes opposite, lobes strongly angled towards leaf apex, regular, up to 4.2–12.4 mm long with rounded or acute apices, margins revolute; pubescent, abaxial surface with greater density of simple grappling-hook, complex grappling-hook, and needle-like trichomes than adaxial surface; adaxial surface with simple grappling-hook and needle-like trichomes. Inflorescence cymose, bract subtending inferior ovary pinnate, 11.7–19.2 × 2.5–6.4 mm. Calyx 6.5–9.4 × 2–2.7 mm, apices acute to attenuate, margins entire. Petals five, yellow, glabrous on abaxial surface, narrowly spatulate, 13.5–18.8 × 5.2–6.6 mm, apex rounded. Androecium yellow, stamens numerous, those of inner whorls shorter than outer whorls, filaments glabrous, anther epidermis not papillate, anther remaining straight following dehiscence; outer whorls of stamens fertile and staminodial, five outermost stamens in median antesepalous positions petaloid, narrowly spatulate, 11.1–16 × 2.7–5 mm, without anther, staminode apex acute; second whorl of stamens all fertile. Gynoecium 3-carpellate, ovary inferior, funnelform, 3 placentae; style 8.4–10.6 mm long, stigmas three. Fruit a capsule, cylindrical, 13.1–14.6 × 5.8–6.9 mm, opening apically by three valves, base tapering, no prominent longitudinal costal ridges. Seeds pale gray with a white wing, lenticular-ovoid, 3.7–3.8 mm long; testa reticulate, seed coat anticlinal cell walls sinuate, central papillae generally 26–51 per cell. Chromosome number $n = 10$ (Christy 1995).

Phenology: Flowering occurs from June to August.

Distribution: Populations occur in sandy washes, along roadsides, and disturbed areas in Apache Co., Arizona, at 1493–2225 m elevation (Fig. 3).

Etymology: We name *M. holmgreniorum* to honor Noel and Patricia Holmgren's contribution to our understanding of *Mentzelia* and their work on the flora of the intermountain West.

Representative specimens: USA. ARIZONA. **Apache Co.**: Vernon, *Bohrer 1100* (ARIZ); Hwy 60, 1 mi W of Springerville, *Dearen 6482* (ARIZ); 16.6 mi SW of Concho, 14 mi E of Showlow along State Hwy 789 & 61, *H. Thompson 3215* (ARIZ); around the headquarters of Canyon de

Chelly National Monument, T05N R10W S22, *Halse 250* (ARIZ); 10 mi SE of Springerville, White Mountains, *L. Benson 9569* (ARIZ); Greer area, *Schmidt 256* (ARIZ); 4 mi E of Mexican Water, *Shreve 8981* (ARIZ).

Henry Thompson called attention to distinctive collections from Apache Co., Arizona, which he annotated using the nomen nudum "showlowensis." Charlotte Christy (1995) also called attention to these populations, which she annotated with the nomen nudem "pinkavae." We agree with Thompson and Christy that these populations are distinct, and this is supported by phylogenetic results (Schenk 2009), in which an exemplar for *M. holmgreniorum* was recovered in a polytomy that included also the morphologically similar species *M. laciniata*, *M. conspicua*, *M. filifolia*, and *M. lagarosa*. *Mentzelia holmgreniorum* has shorter petals than *M. conspicua*, pinnate rather than the entire ovary bracts characteristic of *M. laciniata*, leaf lobes that are acutely angled toward the leaf apex rather than extending perpendicularly from the axis as characteristic of *M. lagarosa*, and broader lamina lobes and rachis than *M. filifolia*.

Mentzelia sivinskii J. J. Schenk & L. Hufford. sp. nov. (Fig. 4A). —Type: USA, New Mexico, San Juan Co.: 5 mi N of Bloomfield, 36°46.750′N, 107°58.876′W, 18 July 2005, *J. Schenk 1021* (holotype: WS; isotypes: NY, UNM, US).

Habitus singularis erectus; caudex singularis; folia alterna angusta elliptica vel lanceolata, margine pinnata; petala 5, flavidus, spatulata; staminodia absentia; seminum testa in alam expansa.

Biennial herbs, up to 7 dm tall; taprooted. Main stem erect, straight, lateral branches on distal half of main stem or along the entire main shoot, lateral branches at acute upward angles to shoot, straight; epidermis pubescent, becoming white, exfoliating with age. Leaves alternate; rosette leaves narrowly to broadly spatulate, petiolate; cauline leaves 33–112.2 × 2.9–11.4 mm, rachis width 1–2.9 mm; leaves on lower third of main stem oblanceolate to elliptic, margins pinnate with 18–24 lobes, 3.7–9.3 mm apart, lobes opposite and perpendicular to leaf axis, regular, up to 0.8–4 mm long with rounded to acute apices, margins revolute; leaves on upper third of main stem elliptic to lanceolate with non-clasping bases, margins pinnate with 6–16 lobes, 3.1–12.7 mm apart, lobes opposite and perpendicular to leaf axis, regular, up to 1–5.1 mm long with rounded to acute apices, margins revolute; pubescent, abaxial surface with equal or greater density of simple grappling-hook, complex grappling-hook, and needle-like trichomes than adaxial surface; adaxial surface with needle-like and occasionally simple grappling-hook trichomes. Inflorescence cymose, bract subtending inferior ovary entire, 5–13.4 × 0.4–0.8 mm. Calyx 5.4–9.3 × 1.2–2.9 mm, apices acute to attenuate, margins entire. Petals five, light yellow to yellow, glabrous on abaxial surface, narrowly spatulate, 9–14.7 × 3.1–6.4 mm, apex rounded. Androecium light yellow to yellow, stamens numerous, those of inner whorls shorter than outer whorls, filaments glabrous, anther epidermis not papillate, anther remaining straight following dehiscence; outer whorls of stamens all fertile, five outermost stamens in median antesepalous positions petaloid, narrowly spatulate, 6.3–11.5 × 2.4–4.9 mm, with anther occasionally borne on a stalk, filament apex rounded, occasionally with notch; second whorl of stamens all fertile. Gynoecium 3-carpellate, ovary inferior, funnelform, 3 placentae; style 4.6–9.9 mm long, stigmas three. Fruit a capsule, cup-shaped, 8.2–12.7 × 5.1–7.7 mm, opening apically by three valves, base tapering to rounded, no prominent longitudinal costal ridges. Seeds pale gray to light brown with a white wing, lenticular-ovoid, 2.7–2.8 mm long; testa reticulate, seed coat anticlinal cell walls sinuate, central papillae generally 12–21 per cell. Chromosome number not determined.

Phenology: Flowering occurs from June to August.

Distribution: Populations are narrowly distributed in San Juan Co., New Mexico, at 1524–1816 m elevation (Fig. 3). Plants occur on knolls, slopes, and roadsides in gypsum or brown clay soils.

Etymology: Early collections of *M. sivinskii* were collected by Robert Sivinski, and we name this entity for his contributions to understanding the flora of New Mexico and the diversity of *Mentzelia*.

Representative specimens: USA. NEW MEXICO. **San Juan Co.**: Jones Mine (abandoned), ca. 2.7 air mi NW of La Plata, 36°58′04″N, 108°12′26″W, *Sivinski 6614* (WS); 27 mi S of the CO border on the NM State Hwy 511, *Kelley 46* (UNM); on old roadbed across dissected highland bordering canyon, T27N R10W S18, SW1/4 of NW1/4, *Lousre 340* (ARIZ).

Schenk (2009) found *M. sivinskii* to be most closely related to *M. integra* and *M. procera* in molecular phylogenetic analyses. *Mentzelia sivinskii* is narrowly distributed in San Juan Co., New Mexico, and it overlaps with the northwestern range of *M. procera*. In contrast, *M. integra* is distributed in the Great Basin, where it is disjunct from its closest relatives. Although the flowers of these three species are similar, the outermost stamens opposite the sepal lobes are fertile in *M. sivinskii* but are staminodial in *M. integra* and *M. procera*. The most distinctive features of *M. sivinskii* compared to its relatives are narrow lobes on leaves and deep sinuses between these lobes, and in these attributes, *M. sivinskii* converges somewhat on leaf attributes of its geographic neighbor *M. laciniata*.

Collections of *M. sivinskii* have been misidentified as *M. multicaulis* (Osterh.) J. Darl. (R.

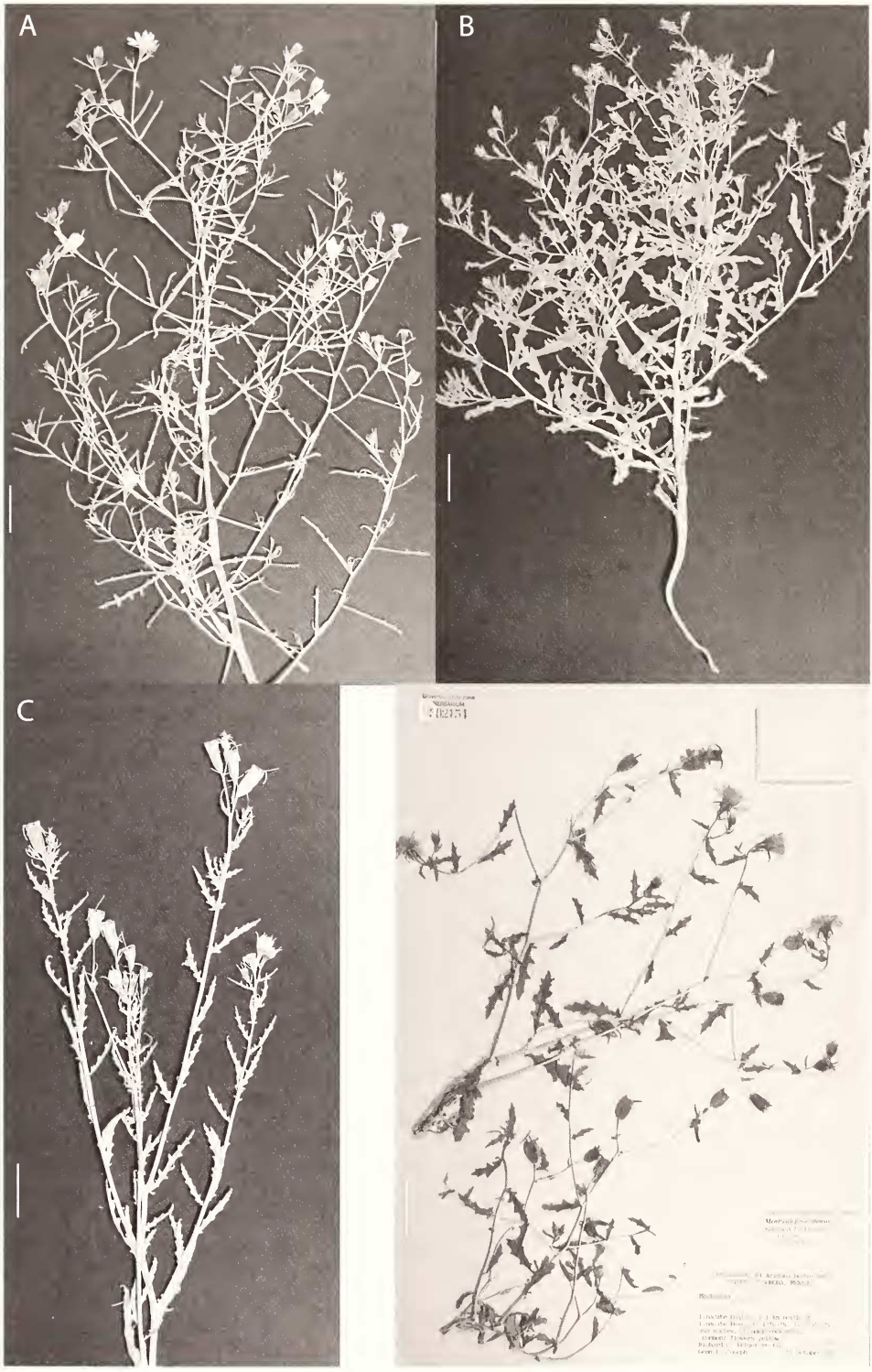

FIG. 4. Type specimens of newly described taxa. A. *Mentzelia sivinskii*, B. *M. longiloba* var. *chihuahuaensis*, C. *M. longiloba* var. *yavapaiensis*, and D. *M. longiloba* var. *pinacatensis*. Scale bars = 3 cm.

TABLE 1. MORPHOLOGICAL STATES OF THE VARIETIES OF *M. LONGILOBA*. MAS = median antesepalous stamens, the outermost stamens opposite sepals. All measurements are in millimeters.

Character	var. *longiloba*	var. *chihuahuaensis*	var. *pinacatensis*	var. *yavapaiensis*
Leaf length	37–112	35–110	35–110	39–71
Leaf width	8.4–24.6	7.4–27.1	5.5–22.0	8.3–19.1
Rachis width	3.3–13.7	2.3–9.0	2.1–7.3	3.5–6.6
Number of lobes	10–28	12–18	8–50	10–24
Lobe length	up to 1.4–6.8	up to 2.3–9	up to 3.3–8.9	up to 2.4–6.5
Petal length	13.3–17.5	11.3–16.3	11.9–19.8	12.6–13.6
Petal width	3.7–6.8	3.1–5.1	4.7–8.9	4.5–5.6
Petal apex	acute to rounded	acute to rounded	rounded	rounded
MAS length	(6.7)10.6–15.5	11.2–15.4	9.7–16.9	11.4–12.8
MAS width	1.9–5.2	2.4–4.0	3.3–5.6	2.9–4.2
MAS staminodial	yes	yes/no	yes/no	no
Capsule length	9.6–16.4	10.0–15.0	7.6–13.2	9.7–15.2
Capsule width	6.0–9.2	5.7–8.3	5.8–8.5	5.7–7.2
Seed length	3.3–4.0	2.9–3.2	2.9–3.4	3.0–3.4
Anticlinal walls	sinuate	straight	sinuate	sinuate
Number of papillae	67–106	4–6	26–51	10–21
Distribution	California, Arizona, New Mexico, Texas, Utah, Sonora	Chihuahua	Sonora	AZ

Sivinski, EMNRD-Forestry Division, personal communication) based on the identification key in Darlington (1934). *Mentzelia multicaulis* is, however, distributed only in western Colorado and eastern Utah (Holmgren and Holmgren 2002). Unlike the perennial *M. multicaulis*, which produces multiple aerial branches from a subterranean caudex (Holmgren and Holmgren 2002; Schenk and Hufford 2009), *M. sivinskii* has a single main stem (Fig. 4).

NEW VARIETIES OF *MENTZELIA LONGILOBA*

Josephine Darlington (1934) first recognized *M. longiloba* as a distinct species distributed in eastern Utah and southern California. Although she differentiated *M. longiloba* from *M. multiflora* (Nutt.) A. Gray on the basis of shorter capsules that have acute bases, Felger (1980) treated the two entities as conspecific and recognized *M. multiflora* subsp. *longiloba* (J. Darl.) Felger. Our phylogenetic studies indicated *M. multiflora s.s.* is more closely related to other mentzelias than it is to *M. longiloba* (Schenk 2009). *Mentzelia multiflora s.s.* can be distinguished from *M. longiloba* by its longer capsules (11.2–26.1 mm versus 7.6–16.4 mm), attenuate rather than rounded capsule bases, and entire rather than pinnate prophylls. We recognize *M. multiflora s.s.* as a taxon limited to the eastern side of the Southern Rocky Mountain Front Range, and we present below a new interpretation of the range of *M. longiloba*.

Our phylogenetic analyses identified a set of morphologically and geographically distinct populations in a polytomy with *M. longiloba s.s.* (Schenk 2009). Although these populations can be distinguished from *M. longiloba s.s.* based on micromorphological states of seed coats, they diverge from it otherwise in largely continuous macromorphological states (Table 1). Given the partially continuous morphological variation of these distinctive populations with *M. longiloba* while having geographical uniqueness, we recognize them as varieties of *M. longiloba*.

Our concept of *M. longiloba* var. *longiloba* is mostly consistent with that of Darlington's (1934) *M. longiloba*, although we recognize additional variation. Based on collections not available to Darlington (1934), we extend the range of *M. longiloba* var. *longiloba* from California and Utah, to include also Arizona, New Mexico, Texas, and northern Mexico. Additionally, we extend the range of morphological variation to recognize longer petals (13.3–17.5 mm) and longer capsules (9.6–16.4 mm).

Among the new varieties of *M. longiloba* we describe below, var. **chihuahuaensis** can be distinguished from the others by the straight anticlinal walls and 4–6 papillae on the outer periclinal wall of seed coat testal cells versus the sinuate anticlinal walls and 10–106 papillae per cell among the other varieties (Table 1, Fig. 5). Variety **yavapaiensis** can be distinguished from var. **pinacatensis** because all stamens, including the petaloid outermost stamens, are fertile, its petals are shorter, and its leaves have a lower maximum number of lobes (Table 1). We distinguish var. **yavapaiensis** from var. *longiloba* primarily by having fewer papillae per outer periclinal wall of seed coat testal cells than the later. The leaves of var. **pinacatensis** are narrower and its capsules shorter than those of the other varieties (Table 1).

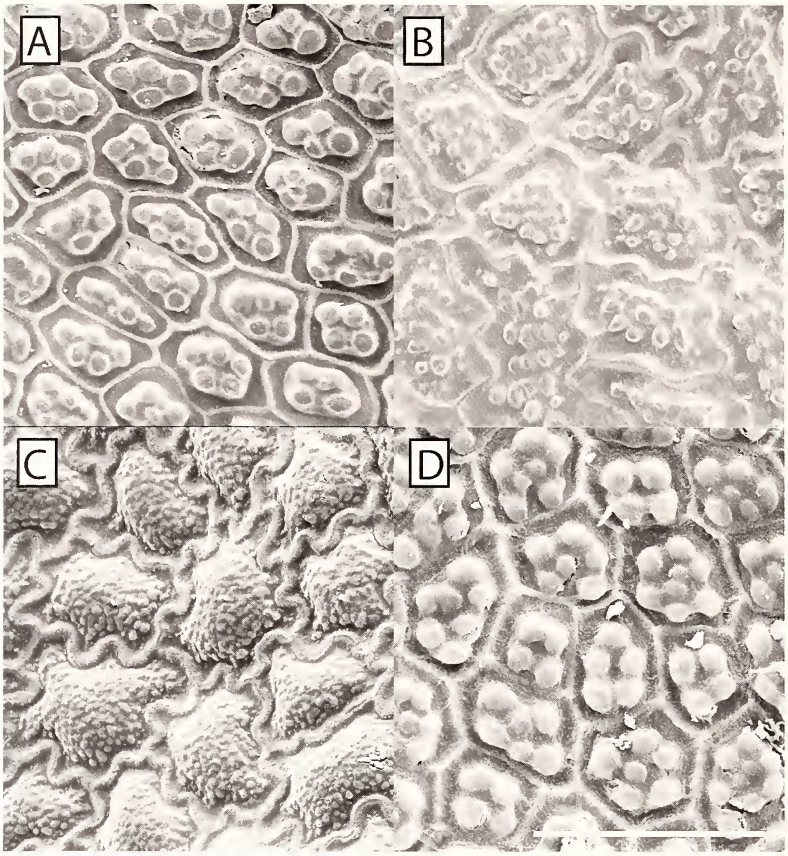

FIG. 5. Scanning electron micrographs of seed coat testal cells. A. *M. longiloba* var. *chihuahuaensis*, B. *M. longiloba* var. *yavapaiensis*, C. *M. longiloba* var. *longiloba*, and D. *M. longiloba* var. *pinacatensis*.

Mentzelia longiloba J. Darl. var. **chihuahuaensis** J. J. Schenk & L. Hufford var. nov. (Fig. 4B). —Type: USA, Texas, Brewster Co., Rte 118, S of 898, on W side of rd with E exposure, 30°05.898′N, 103°35.782′W, 1385 m elevation, 7 Aug 2004, *J. Schenk 901* (holotype: WS; isotypes: ARIZ, NY, UNM, TEX, US).

Habitus singularis erectus; caudex singularis; folia alterna elliptica vel lanceolata, margine lobata; petala 5, flavidus, spatulata; staminodia extima petaloidea; seminum testa in alam expansa.

Biennial herbs, up to 5 dm tall; taprooted. Main stem erect, straight, lateral branches on distal half of main stem or along the entire main shoot, lateral branches at acute upward angles to shoot, upwardly curved; epidermis, pubescent, becoming white or gray, exfoliating with age. Leaves alternate; rosette leaves narrowly to broadly spatulate, petiolate; cauline leaves 35–110 × 7.4–27.1 mm, rachis width 2.3–9 mm; leaves on lower third of main stem oblanceolate to elliptic, margins dentate with 12–18 lobes, 8.4–12.5 mm apart, lobes opposite and perpendicular to leaf axis, regular, up to 2.3–9 mm long with rounded to acute apices, margins revolute; leaves on upper third of main stem lanceolate with nonclasping bases, margins serrate to pinnate with 10 lobes, 6.8–9.4 mm apart, lobes opposite and slightly angled towards leaf apex, regular, up to 2.9–7.5 mm long with rounded to acute apices, margins revolute; pubescent, abaxial surface with greater density of simple grappling-hook, complex grappling-hook, and needle-like trichomes than adaxial surface; adaxial surface with simple grappling-hook and needle-like trichomes. Inflorescence cymose, bract subtending inferior ovary entire to rarely pinnate, 5.2–9.9 × 0.7–2.6 mm. Calyx 5.5–8.8 × 1.9–3.3 mm, apices acute to attenuate, margins entire. Petals five, yellow, glabrous on abaxial surface, narrowly spatulate, 11.3–16.3 × 3.1–5.1 mm, apex acute to rounded. Androecium yellow, stamens numerous, those of inner whorls shorter than outer whorls, filaments glabrous, anther epidermis not papillate, anther remaining straight following dehiscence; outer whorls of stamens fertile and staminodial, five outermost stamens in median antesepalous positions petaloid, narrowly spatulate, 11.2–15.4 × 2.4–4 mm, without anther, staminode apex acute to rounded; second whorl of stamens all fertile. Gynoecium 3-carpellate, ovary inferior, funnel-

form, 3 placentae; style 6.4–9.8 mm long, stigmas three. Fruit a capsule, cup-shaped, 10–15 × 5.7–8.3 mm, opening apically by three valves, base tapering, no prominent longitudinal costal ridges. Seeds light brown with a white wing, lenticular-ovoid, 2.9–3.2 mm long; testa reticulate, seed coat anticlinal cell walls straight, central papillae generally 4–6 per cell. Chromosome number not determined.

Phenology: Flowering occurs from August to November.

Distribution: Populations occur in the Chihuahuan Desert in New Mexico and Texas in the United States and Chihuahua and Coahuila states of northeastern Mexico at 548–1555 m elevation (Fig. 3). Plants occur on sand dunes and along roadsides in dry clay or sandy soils that are often disturbed.

Etymology: *Mentzelia longiloba* var. *chihuahuaensis* is named for the Chihuahuan Desert, to which it is endemic.

Representative specimens: MEXICO. CHIHUAHUA. Samalayuca Dunes, ca. 5 miles S of Samalayuca, and ca. 35 mi S of Cuidad Juarez, 31°17′N, 106°30′W, *Provance et al. 1678* (UCR). COAHUILA. along Rio Grande, just S of Ojo Caliente, river mileage 808.3, 29°11′N, 102°56′W, *Hodgson et al. 5265* (UCR). USA. NEW MEXICO. **Hidalgo Co.**: Taylor Draw at Animas Creek in Upper Animas Valley, 0.4 mi N of the jct with the rd over the mountains to Douglas, on Rte 338, T31S R20W S33, *Sanders et al. 3051* (UCR). TEXAS. **Brewster Co.**: E of Marathon, across from Housetop Mtns on Hwy 90, on S side of rd with N exposure, 30°12.233′N, 102°57.562′W, *Schenk 909*, 910 (WS); Route 118, at intersection with Calamity Creek Rd, S of Alpine, 30°10.173′N, 103°35.031′W, *Schenk 898, 900* (WS); S-facing road-cut on Hwy 90 just E of Alpine (across from stinking cattle feedlot), 30°22.539′N, 103°36.658′W, *Hufford 4311* (WS). **Jeff Davis Co.**: Route 17, S of Boy Scout camp by a few mi, Davis Mountains, N of Fort Davis, 30°48.954′N, 103°45.869′W, *Schenk 897* (WS). **Terrell Co.**: along Hwy 90, E of Sanderson and Dryden, 1 mi W of Lozier Canyon, 4 mi W of jct with Hwy 1865 (to Pumpville), and ca. 15 mi W of Langtry, 29°54.296′N, 101°49.263′W, *Hufford 4312* (WS).

Collections of *M. longiloba* var. *chihuahuaensis* are often identified as *M. multiflora*, but their seed coat testal cells can readily distinguish them. Seed coat cells of *M. longiloba* var. *chihuahuaensis* have straight anticlinal walls and 4–6 papillae that are centrally located on a raised dome of the outer periclinal wall of each testal cell (Fig. 5), whereas testal cells of *M. multiflora* have sinuate anticlinal walls and 34–48 papillae per cell (Fig. 1). Although the northern portion of the range of *M. longiloba* var. *chihuahuaensis* extends into southern New Mexico (Fig. 3), it does not overlap with the range of *M. multiflora*, which reaches it southern limit in northern New Mexico. The range of *M. longiloba* var. *chihuahuaensis* marginally overlaps with the southern range of *M. procera*, which can be differentiated from *M. longiloba* var. *chihuahuaensis* by the sinuate anticlinal walls of its seed testal cells (Fig. 1c), more narrow leaves (5.3–14.9 mm vs. 7.4–27.1 mm) with a narrower rachis (1.7–3.9 mm vs. 2.3–9 mm), a wide leaf base, and greater number of lobes (14–26 vs. 12–18).

Mentzelia longiloba J. Darl. var. **pinacatensis** J. J. Schenk & L. Hufford var. nov. (Fig. 4D). —Type: MEXICO, Sonora, Pinacate Region, 1.1 km N of Pinacate Peak, 31°47′05″N, 113°29′25″W, 950 m elevation, 13 Oct 1986, *R. Felger & G. Joseph 86-432* (holotype: ARIZ; isotypes: ARIZ, RSA).

Habitus singularis erectus; caudex singularis; folia alterna elliptica vel lanceolata, breva, margine lobata; petala 5, flavidus, spatulata; staminodia extima petaloidea; seminum testa in alam expansa.

Biennial herbs, up to 5 dm tall; taprooted. Main stem erect, straight, lateral branches along the entire main shoot, lateral branches at acute upward angles to shoot, upwardly curved; epidermis pubescent, becoming white, exfoliating with age. Leaves alternate; rosette leaves narrowly to broadly spatulate, petiolate; cauline leaves 35–110 × 5.5–22 mm, rachis width 2.1–7.3 mm; leaves on lower third of main stem elliptic, margins dentate to pinnate with 18–50 lobes, 2.9–18.2 mm apart, lobes opposite and perpendicular to leaf axis, irregular or regular, up to 3.3–6.9 mm long with acute apices, margins revolute; leaves on upper third of main stem elliptic to lanceolate with non-clasping bases, margins dentate to pinnate with 8–28 lobes, 2.1–5.5 mm apart, lobes opposite and perpendicular to leaf axis, irregular or regular, up to 1.7–8.9 mm long with acute apices, margins revolute; pubescent, abaxial surface with greater density of simple grappling-hook, complex grappling-hook, and generally with needle-like trichomes than adaxial surface; adaxial surface with simple grappling-hook and needle-like trichomes. Inflorescence cymose, bract subtending inferior ovary entire, toothed, or pinnate, 5.4–15.7 × 0.7–2.8 mm. Calyx 6.7–13.6 × 1.7–3.5 mm, apices acute to attenuate, margins entire. Petals five, yellow, glabrous on abaxial surface, narrowly spatulate, 11.9–19.8 × 4.7–8.9 mm, apex rounded. Androecium yellow, stamens numerous, those of inner whorls shorter than outer whorls, filaments glabrous, anther epidermis not papillate, anther remaining straight following dehiscence; outer whorls of stamens fertile or staminodial, five outermost stamens in median antesepalous positions petaloid, narrowly spatu-

late, 9.7–16.9 × 3.3–5.6 mm, with or without anther, filament or staminode apex rounded; second whorl of stamens all fertile. Gynoecium 3-carpellate, ovary inferior, funnelform, 3 placentae; style 7.6–11.4 mm, stigmas three. Fruit a capsule, cup-shaped, 7.6–13.2 × 5.8–8.5 mm, opening apically by three valves, base rounded, no prominent longitudinal costal ridges. Seeds light brown with a white to light brown wing, lenticular-ovoid, 2.9–3.4 mm long; testa reticulate, seed coat anticlinal cell walls sinuate, central papillae generally 26–51 per cell. Chromosome number not determined.

Phenology: Flowering occurs from March to April.

Distribution: Populations are distributed in the Pinacate Desert of Sonora, Mexico, at 200–950 m elevation (Fig. 3). Plants occur on slopes in soils composed largely of decomposed volcanic cinder rocks and ash.

Etymology: *Mentzelia longiloba* var. *pinacatensis* is named for the Pinacate Desert, to which it is restricted.

Representative specimens: MEXICO. SONORA. Pinacate Region, ash flat adjacent to N end of Mayo lava flow, 2 April 1989, *Dimmitt s.n.* (ARIZ); ca. 1.8 km NWW of Pinacate Peak, 31°46.5′N, 113°30′W, *Felger et al. 19475* (ARIZ); Pinacate Region, ca. 0.5 km W of Campo Rojo (=Red Cone Camp), 31°46′N, 113°27′W, *Felger et al. 87-56* (ARIZ); lava flow NE of Crater Elegante, 31°50′30″N, 113°20′W, *Fishbein & Meggs 30* (ARIZ); E trail of Pinacate Peak, Sierra Pinacate, NW Sonora, 31°45′N, 113°30′W, 9 Apr 1983, *Sherbrooke s.n.* (ARIZ); Pinacate Mountains, Red Cone Camp, 31°47′N, 113°27′W, 19 Mar 1983, *Soule s.n.* (ARIZ); Sierra del Pinacate, SE of Pinacate Peak, 31.55′N, 113.25′W, *Webster 22298* (ARIZ).

The Pinacate region of northern Mexico has been shaped by recent volcanic activity during the Pleistocene to Holocene (Ezcurra et al. 1987), and *M. longiloba* var. *pinacatensis* is one of several endemic taxa that appear to have evolved on its distinctive soils (Felger 1991). Collections of this taxon have been previously identified as *M. longiloba* (or *M. multiflora* subsp. *longiloba*). Varity *pinacatensis* has shorter leaves, more numerous lobes per leaf, narrower petals, petaloid fertile stamens rather than staminodes in outermost androecial positions opposite sepals, and shorter capsules compared to *M. longiloba* var. *longiloba* (Table 1).

Mentzelia longiloba J. Darl. var. **yavapaiensis** J. J. Schenk & L. Hufford var. nov. (Fig. 4C). — Type: USA, Arizona, Yavapai Co., Juniper Mountains, W of Flagstaff, Cross Mountain Rd, near Hwy I-40, 35°11.767′N, 113°18.280′W, 1576 m elevation, 1 July 2005, *J. Schenk 1011* (holotype: WS; isotype: ARIZ).

Habitus singularis erectus; caudex singularis; folia alterna elliptica vel lanceolata, margine lobata; petala 5, flavidus, spatulata; staminodia extima petaloidea; seminum testa in alam expansa; chromosoma noven.

Biennial herbs, up to 7 dm tall; taprooted. Main stem erect, straight, lateral branches on distal half of main shoot, lateral branches at acute upward angles to shoot, upwardly curved; epidermis pubescent, becoming white, exfoliating with age. Leaves alternate; rosette leaves narrowly to broadly spatulate, petiolate; cauline leaves 39–71 × 8.3–19.1 mm, rachis width 3.5–6.6 mm; leaves on lower third of main stem oblanceolate to elliptic, margins pinnate with 14–24 lobes, 3.1–9.6 mm apart, lobes opposite and slightly angled towards leaf apex, irregular or regular, up to 2.4–6.5 mm long with rounded or acute apices, margins revolute; leaves on upper third of main stem lanceolate with non-clasping bases, margins pinnate with 10–20 lobes, 5–10.2 mm apart, lobes opposite or alternate and slightly angled towards leaf apex, irregular or regular, up to 2.6–5.8 mm long with rounded or acute apices, margins revolute; pubescent, abaxial surface with greater density of simple grappling-hook, complex grappling-hook, and occasionally needle-like trichomes than adaxial surface; adaxial surface with simple grappling-hook and needle-like trichomes. Inflorescence cymose, bract subtending inferior ovary entire, 4.6–14.5 × 0.3–1.1 mm. Calyx 7.2–8.1 × 1.9–2.3 mm, apices acute to attenuate, margins entire. Petals five, yellow, glabrous on abaxial surface, narrowly spatulate, 12.6–13.6 × 4.5–5.6 mm, apex rounded. Androecium yellow, stamens numerous, those of inner whorls shorter than outer whorls, filaments glabrous, anther epidermis not papillate, anther remaining straight following dehiscence; outer whorls of stamens fertile and staminodial, five outermost stamens in median antesepalous positions petaloid, narrowly spatulate, 11.4–12.8 × 2.9–4.2 mm, without anther, staminode apex acute to rounded; second whorl of stamens all fertile. Gynoecium 3-carpellate, ovary inferior, funnelform, 3 placentae; style 8.8–10.6 mm long, stigmas three. Fruit a capsule, cup-shaped to cylindrical, 9.7–15.2 × 5.7–7.2 mm, opening apically by three valves, base tapering to rounded, no prominent longitudinal costal ridges. Seeds pale gray with a white wing, lenticular-ovoid, 3–3.4 mm long; testa reticulate, seed coat anticlinal cell walls sinuate, central papillae generally 10–21 per cell. Chromosome number $n = 9$ (*H. Thompson 3405* [ARIZ]).

Phenology: Flowering occurs from March to October.

Distribution: Populations are located in Apache, Coconino, Mohave, Navajo, Pinal, and Yavapai counties in Arizona, where they occur in sandy washes and along roadsides at 432–1676 m elevation (Fig. 3).

Etymology: *Mentzelia longiloba* var. *yavapaiensis* is named for Yavapai Co., Arizona, where the type specimen was collected.

Representative specimens: USA. ARIZONA. **Coconino Co.**: Wupatki National Monument, Flagstaff, *Demaree 43981* (ARIZ). **Mohave Co.**: 4 mi W of Peach Springs, *Kearney & Peebles 12747* (ARIZ); Hualapai Mountains, SE of Hualapai Mountain Park, 35°05′N, 113°52′W, *Vasek & Clarke HMS-112* (UCR); Tuweep, rim of Grand Canyon, *Cottam 8594* (ARIZ); along main rd between Wolf Hole and Cottonwood Wash, T38N R15W S36, *Mason & Phillips 2885* (ARIZ). **Navajo Co.**: Corduroy Canon, 20 mi SW of Show Low along US Hwy 60, *H. Thompson 3218* (ARIZ); State Rte 77, ca. 11 mi S of Navajo Indian Reservation boundary, 3 mi S of Leroux Wash, T19N R21E, 23 Sep. 1973, *Spaulding s.n.* (ARIZ); near Oraibi, 24 July 1958, *Haskell & Hevly s.n.* (ARIZ); Newberry Mesa N of Winslow, 9 June 1940, *Darrow s.n.* (ARIZ); Winslow, *M. Jones 4112* (ARIZ). **Pinal Co.**: Casa Grande Ruins National Monument, *D. Turner & DeKoker 59* (ARIZ); Pinal Mountains, *Kearney et al. 6364* (ARIZ); Sacaton Agency, *Gilman 220* (ARIZ); San Pedro Valley, 4.9 mi SE of Main St in San Manuel via rd to San Pedro River, dissected lower Bajada ca. 1 mi W of river, T10S R18E, *Burgess & Burgess 5950* (ARIZ); W of Gila Butte beneath and around new overpass bridge, *S. Adams 34* (ARIZ). **Yavapai Co.**: about 80 mi SE of Kingman, *Keaney & Peebles 12586* (ARIZ); Antelope Creek, S Weaver Mountains, Yarnell 7.5 Quad, T10N R04W S19 NW1/4, *Butterwick & Hillyard 6871* (ARIZ); Black Hills, 5 mi E of Cherry, 34°35′26″N, 111°59′46″W, *Helmkamp 7-17* (UCR); Lynx Lake area of Prescott National Forest, 4.8 mi S of Hwy 69 on 197, ca. 6 mi SE of Prescott, *L. & S. Landrum 5591* (UCR); Page Springs, *Demaree 44336* (ARIZ); Prescott National Forest, 7.8 mi SW of Prescott on Hwy 89, 34°27′N, 112°32′W, *Vasek & Clarke 660911-54* (UCR); SW of Prescott, 2 mi SW of Kirkland Junction, *H. Thompson 3405* (ARIZ).

Collections of *Mentzelia longiloba* var. *yavapaiensis* have often been determined as *M. multiflora*, which is consistent with Darlington's (1934) broad treatment of the latter species. The phylogenetic results of Schenk (2009) demonstrated that Darlington's (1934) concept of *M. multiflora* encompassed polyphyletic lineages. *Mentzelia longiloba* var. *yavapaiensis* is more closely related to *M. longiloba* var. *pinacatensis* than it is to *M. multiflora s.s.* (Schenk 2009). *Mentzelia longiloba* var. *yavapaiensis* has short, cup-shaped capsules in contrast to the long, cylindrical capsules of *M. multiflora s.s.*

Identification Key to *Mentzelia* section *Bartonia* for Taxa Discussed Above

1. Plants with multiple stems that arise from a subterranean branching caudex, plants often forming rounded tufts . . . . . *M. multicaulis*
1′ Plants with a simple caudex (=single main stem, or multiple stems that arise from a single region) at or above the soil surface
  2. Petals pubescent on abaxial surfaces
    3. Most leaves above the base of plant shallowly lobed with rounded to acute margins or entire, especially on the secondary and tertiary branches; outer stamens opposite each sepal with anther; w. CO. . . . . *M. marginata*
    3′ Most leaves (except prophylls) pinnately lobed on all orders of branches, lobes acute; outer stamens opposite each sepal with/without anther; w. CO, AZ, NW, UT
      4. Lateral branches at acute angles to the main stem and extend to near the distal end of the plant (creating a candelabrum profile with a flat to round top); capsules 6–16 × 5–7.3 mm; AZ, CO, NM, UT . . . . . *M. cronquistii*
      4′ Lateral branches perpendicular or acutely angled to main shoot, generally of nearly equal lengths, lateral branching often dense (creating a cylindrical profile); capsules 5–9 × 3.7–6.5 mm; Montrose and San Miguel counties, CO . . . . . *M. paradoxensis*
  2′ Petals glabrous on abaxial surfaces
    5. Leaves along main stem pinnatisectly lobed
      6. Petals 27 mm or longer . . . . . *M. conspicua*
      6′ Petals less than 26 mm long
        7. Petals 13 mm long or less and floral bracts subtending ovaries pinnate . . . . . *M. lagarosa*
        7′ Petals greater than 13 mm long and floral bracts subtending ovary entire to pinnate
          8. Lamina lobes filiform, 1.4 mm wide or less, lobes up to 17 mm long. . . . . *M. filifolia*
          8′ Lamina lobes narrow, greater than 1 mm wide, lobes up to 14.4 mm long
            9. Entire bracts subtending ovaries; leaf lobes slightly angled toward distal tip of leaf or perpendicular to leaf axis; NM and CO. . . . . *M. laciniata*
            9′ Pinnate bracts subtending ovaries; leaf lobes strongly angled toward distal tip of leaf; AZ. . . . . *M. holmgreniorum*
    5′ Leaves along main stem entire, dentate, serrate, to pinnately lobed
      10. Largest trichomes of leaves with ring-like pedestals of pearly white cells; leaf lobes angled on proximal side of lobe, perpendicular on distal side of lobe; stem epidermis generally glabrous or occasionally pubescent, leaf lobes few, generally less than 12 . . . . . *M. integra*

10′ Leaf trichomes of leaves without ring-like pedestals of pearly white cells; leaf lobes with isometrically angled sides; stem pubescent, leaf lobes many, generally greater than 6
11. Anticlinal walls of testal cells straight
12. Capsules cup-shaped (less than or equal to twice as long as wide)
13. Capsules 9.6–19 mm long; 4–6 papillae per testal cell . . . . . *M. longiloba* var. *chihuahuaensis*
13′ Capsules 5.3–13 mm long; 8–12 papillae per testal cell. . . . . *M. mexicana*
12′ Capsules cylindrical (greater than twice as long as wide). . . . . *M. pumila*
11′ Anticlinal walls of testal cells sinuate
14. Seed periclinal wall with 67 or more papillae per cell . . . . . *M. longiloba* var. *longiloba*
14′ Seed periclinal wall with 68 or fewer papillae per cell
15. Outermost stamens opposite sepal lobes with anther
16. Leaf rachis 1–2.9 mm wide . . . . . *M. sivinskii*
16′ Leaf rachis 3.5–6.6 mm wide . . . . . *M. longiloba* var. *yavapaiensis*
15′ Outer stamens opposite each sepal lobes generally staminodial
17. Capsules 5.3–13 mm long; plants occur on volcanic soils . . . . . *M. longiloba* var. *pinacatensis*
17′ Capsules 9.6–26 mm long; plants occur on loam soils
18. Upper leaf rachis 1.7–3.9 mm wide; capsules 5.2–7.3 mm wide. . . . . *M. procera*
18′ Upper leaf rachis 2.1–13.7 mm wide; capsules 5.1–9.2.mm wide. . . . . *M. multiflora*

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